

21st Century Neuroscience

From [CAARE Citizens for Alternatives to Animal Research and Experimentation](#)

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Discussion of high-quality, human-relevant alternatives to animals to study the brain and neurological disorders. With numerous examples of cutting-edge research, they show how human-relevant methods can and must replace this category of animal experiments.



One of the largest categories of animal research involves painful and invasive brain experiments done purportedly to understand the human brain and neurological diseases. While animal experiments routinely fail to model human disease, this area of research has been especially unsuccessful. Most of our neurological and psychiatric diseases are without effective treatments and even fewer have cures.

CAARE's president, Barbara Stagno, and Richard Miller PhD, Professor Emeritus of Pharmacology at Northwestern University Feinberg School of Medicine have published an article discussing high-quality, human-relevant alternatives to animals to study the brain and neurological disorders. With numerous examples of cutting-edge research, they show how human-relevant methods can and must replace this category of animal experiments. Dr. Miller is the author of the 2023 book [“The Rise and Fall of Animal Experimentation”](#) and has recently joined CAARE as scientific advisor.



Lab caged squirrel monkey

Advances in animal-free research to study neurological disease are growing and improving. Researchers at University of Wisconsin-Madison have refined 3D bioprinted brain tissue that replicates key brain functions and believe it will help us to study diseases like Alzheimer's and Parkinson's. At University

of Essex in the UK, scientists are using AI and brain scans of children who experienced trauma, rather than inflicting stress on baby animals to reveal new information on how trauma impacts developing brain function and provide new directions for treatment.

All of this is part of a technical revolution in biology and medicine that has at long last led the NIH to issue a statement that it will prioritize non-animal research because of “dramatic leaps in technologies that allow researchers to use complementary, non-animal-based approaches to study biological functions and human disease.”

Much of the language in the NIH announcement mirrors the text of the [Human Research and Testing Act](#), drafted and introduced by CAARE in 2021, which called for NIH to create a center for alternatives to animals by providing funding, training and incentivizing scientists on the use of non-animal alternatives.

Moving past animal experiments to understand human neurological disease

[Monkeys, mice and other animals are inadequate for studying human biology](#), especially relating to the brain and neurological diseases. While the failure rate for drug development using animals is 90%, it is a whopping 99.6% for Alzheimer’s.

Differences between the human and primate brain are significant and include fundamental disparities in neuronal types, laminar distribution, gene expression profiles, and more. Monkeys and rodents – though they are used extensively in brain research – do not suffer from Alzheimer’s, Parkinson’s, depression, or the vast range of neurological and psychiatric conditions unique to humans.

Superior, human-relevant technologies that include human brain organoids, live brain imaging, post-mortem brain tissue are available and must replace animals in order to see progress in treating diseases of the brain and nervous system.

NIH statement on catalyzing the development of non-animal methods



In an [historic statement](#), the U.S. National Institutes of Health (NIH) announced on February 1, 2024 that it will now prioritize the development and use of novel alternative methods (NAMs) that can replace animals.

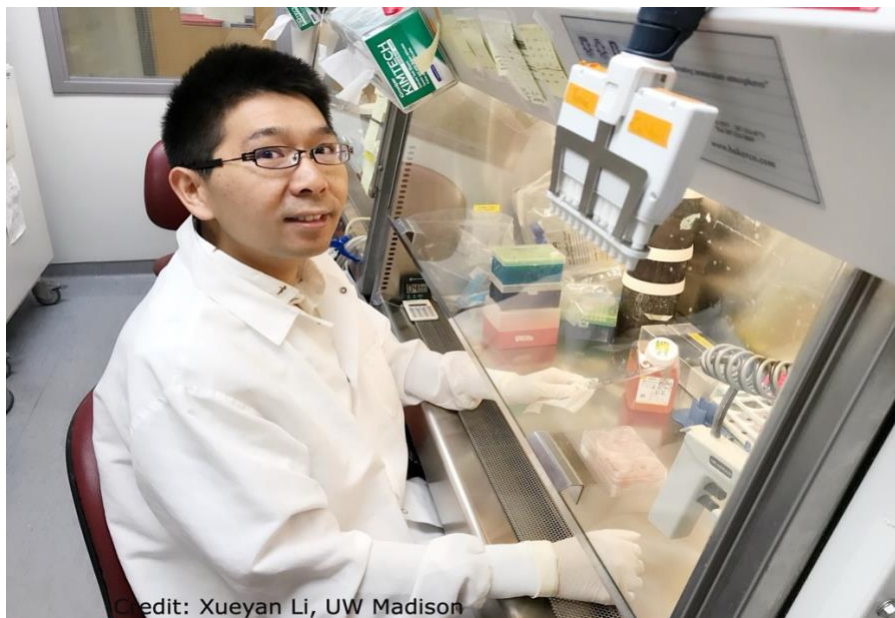
The decision was made based on a report from the Advisory Committee to the Director (ACD), which concluded that prioritizing NAMs was vital because of the technological advancements seen in non-animal methods such as computational modeling, cell-free methods, cell-based culture models, and more.

The ACD report recommended that the NIH invest in comprehensive training to advance the development and use of NAMs, and to establish resources, infrastructure, and collaborations to produce high quality standardized data sets from NAM research.

In support of this, the NIH's Council of Councils approved a new research program called Complement Animal Research in Experimentation (Complement-ARIE), that will accelerate the development, standardization, validation and use of NAMS.

Monica M. Bertagnoli, M.D., the new director of the NIH, stated that utilizing NAMs will “provide new tools that will transform the way that we do basic, translational and clinical research and accelerate progress toward all people living longer, healthier and happier lives.”

Researchers 3D-print functional human brain tissue



Researchers at the University of Wisconsin-Madison have developed the first [3D-printed brain model](#) that accurately mimics the human brain.

Previous bioprinting attempts were unsuccessful in deriving functional brain tissue, but in this research, neuroscientists stacked cell layers horizontally instead of vertically and neurons were placed in a softer “bio ink” gel than traditional tissue printing. This resulted in enough structure for the cells to be held together while providing enough room for the neurons to grow and communicate with each other, an essential feature of brain function.

This human-derived brain tissue is important because it will enable scientists to study neurological disorders such as Alzheimer's and Parkinson's disease, conditions that are not replicated in animals.

As the [authors state](#): “Animal models cannot precisely recapitulate the high-order information processing of the human brain due to the differences in neuronal composition, synaptic integration, astrocytic complexity, and neural networks between animals and humans.”

World's largest childhood trauma study uncovers brain rewiring



Researchers at the University of Essex, led by Megan Klabunde PhD, [utilized artificial intelligence \(AI\)](#) to reexamine human brain imaging studies involving trauma and the brain in childhood, rather than studying the brains of emotionally tormented baby animals.

The studies examined brain scans of over 580 children who had undergone functional magnetic resonance imaging (fMRI) scans, which show neurological activity by tracking blood flow.

They found a significant difference between normal brain function in healthy control subjects and children who experience trauma that occurred in the brain's default mode (DMN) and central executive networks (CEN). The DMN and CEN are two large brain systems involved in how people process their sense of self and their internal reflections. These results point to the need to utilize existing treatment techniques that can rewire brain centers of patients, such as cognitive retraining, transcranial magnetic stimulation and more.